B&W ADVANCED TECHNOLOGY LESSON PLAN		
Lesson No. 506-40	Title: ANO1 PARTIAL LOSS OF FLOW	
Written by: Paul Gage	Approved by: Larry Bell	Date: 11/14/91

1.0 Training Aids

1.1 Transparency package
1.2 ICS Color Transparency

2.0 Reference Material

2.1 B&W Advanced Manual - Chapter 28
2.2 Nuclear Power Experience - Vol 2 Book 3 Section VII
2.3 10 CFR 50.72

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3.0 Objectives

3.1 Explain actions of rapid feedwater reduction circuits on ICS and feedwater components

3.2 Explain cause of RCS overcooling

3.3 Explain how reverse flow occurred from RCS to HPI

3.4 State the concern over reactor coolant flow into HPI system.

4.0 Presentation

4.1 Initial Conditions

Appendix p 28-4

1/20/89
100% power
Normal temperature
Normal pressure

4.2 Electrical problems

4.2.1 Exciter

Failed exciter winding (low vibration induced crack)

Voltage spikes (generator exciter field)
Normal = 50 vdc
Spikes = 90 vdc ... 150 vdc (pegged)
Operators place voltage regulator to MANUAL
Loss of generator field

4.2.2 Generator lockout (on loss of field)
Opens field breakers
Opens output breakers
Trips turbine ... Reactor trip (anticipatory)

4.2.3 Non-safety 6.9Kv bus fails (fast) auto transfer (H1)

H1 bus did transfer but it was SLOW (reset time on sync check relay)

A1 & A2 (safety) buses transfer ... OK
H2 bus transfers ... OK
(Transfer from Unit Aux Xfr to S/U Xfr)
RCPs A and C trip on UV (powered from H1)

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Steam line pressure osc. after turbine stop valves closed & time delay problem.	4.3 Feedwater problems (Figure 28-1) 4.3.1 Spurious EFIC initiation 2 channels (low OTSG level) ... actual > setpt Nothing started ... logic NOT satisfied 4.3.2 Rapid Feedwater Reduction Actuated on RT to: Close S/U valve Close Low load control valve Close Block valve Open cross-over valve (pump discharge) Run pump speed to minimum Close pump speed discharge valves
wiring error mech overload (torque sw. setpt) Pump controller or steam supply prob.	4.3.3 'B' Main Feedwater (overfeed condition) S/U valve fails OPEN Low load valve fails OPEN Block valve fails OPEN Pump fails to runback to min. speed 4.3.4 Operator actions Manually close MFIV (high OTSG level) reopened to control level Manually close 'B' block valve Stopped 'B' pump Used 'A' pump to feed both OTSGs manual control of feed valves
	4.4 HPI back flow (Figure 28-2)
Tape (melted and smoldered) left on HPI piping	4.4.1 Smoke alarm actuated
	4.4.2 High temperature (B & C & cross-over lines) Rated at RCS pressure but NOT temperature
Thermal stress > design in piping outside RB ... Event V	4.4.3 'B' line check valve (inside RB) failed OPEN HPI (standby) had been started and stopped by operators
	4.4.4 RCPs A&C restarted to remove Δp

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weld defect

4.5 RCS leakage

4.5.1 Noted on post trip walkdown of RB
10 - 20 ml / min.

4.5.2 Elbow weld in drain line off RCP 'B' suction

4.5.3 RCS boundary leakage
Tech. Specs. require C/D begin W/I 24 hrs.
Unusual Event declared

4.6 NRC Notifications

4.6.1 Reactor trip

4.6.2 EFIC initiation

4.6.3 UE declared

4.7 Inspections & Analysis

4.7.1 ***Engr thermal stress analysis*** ... HPI overstressed

4.7.2 ***Weld samples*** inspected for degradation ... none found
Due to thermal movement of pipe into interferences.

4.7.3 ***Check valves inspected*** ... excessive wear in hanger bushing connection & binding of disk anti-rotation pins.
Bushing became wedged on bracket stop.

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4.8 Changes

4.8.1 Replaced piping components

4.8.2 Modified bushing & anti-rotation pins

4.8.3 Additional check valves installed inside RB (each line)

4.8.4 Vents & drains installed (backleakage testing)

4.8.5 Temperature indicators installed in piping (aux bldg)

4.8.6 Procedure changes
Backleakage test procedure
New AOP for high HPI temperature
Operation logs add local temp readings (once per shift)

5.0 Background note

The HPI system was modified in 1979 to add crossover lines between the B&C and the A&D HPI lines after identifying the most limiting location for a SBLOCA as being in the RCP discharge piping. The modification created the potential for RCS backflow with the failure of a single check valve and unbalanced RCP operation. However, the potential for such an event was apparently not recognized.